radioactivity DETECTOR

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THE high voltage required to operate geiger tubes in portable equipment is usually obtained from h.t. batteries. This article describes a method for operating one of these tubes from a 7·5V battery and eliminates the need for rather large and cumbersome power supplies. The pulses produced by the radioactive particles are heard as "clicks" in the loudspeaker or, if the constructor so wishes, they can be fed into a scaler and counted in this way.

Referring to the circuit diagram, Fig. 1, it can be seen that basically the design consists of a static inverter followed by a voltage doubler circuit to give the high tension required to operate the tube. The inverter is an astable multivibrator with regeneration provided by R3 and R4. The primary of the transformer forms the load for Tr1 and Tr2 while resistors R1 and R2 ensure that the transistor leakage current is kept to a minimum.

For correct operation of the tube 400V is required. If the voltage is too low the tube will fail to trigger when a radioactive particle enters it. If on the other hand it is too high a continuous discharge will take place. To control this voltage a 100Ω pre-set resistor was inserted between one terminal of the battery and the inverter and this can be adjusted to give the correct operating voltage on the tube.

Whenever a radioactive particle enters the tube it ionises some of the gas particles. The negative ions produced in this way will move towards the anode while the positive ions move to the cathode. Some of these charged particles accelerated by the high voltage will collide with other gas molecules causing further ionisation and so a rapid discharge of the tube follows. This pulse is taken from across R5 and fed via C3 to the transistor amplifier. R6 acts as a buffer resistor to limit the current drawn from the geiger tube. If too much current were drawn then the voltage across C2 would drop below 400V with the result that if a number of particles were to follow in quick succession some would fail to register.

The super alpha pair Tr3 and Tr4 further increase the input impedance of the amplifier and biasing resistors were found to be unnecessary as the input pulse was of a sufficiently high amplitude to bias the transistors on. In the absence of a pulse no current flows through Tr3 and Tr4. Consequently the voltage across R7 will be virtually zero and this ensures that Tr5 is biased off and so no current flows through the loudspeaker. When the tube is triggered the negative going pulse biases Tr3 and Tr4 on, and the current flowing through them causes a voltage drop across R7 which in turn biases Tr5 on and this gives rise to a 'click' in the loudspeaker.

Some constructors may find the pulse amplifier

★ components list

Resistors:

R1	470 Ω	R5	2·2M Ω
R2	470 Ω	R6	330k Ω
R3	2·2k Ω	R7	4·7k Ω
R4	2·2k Ω	VR1	100 Ω preset

Capacitors:

C1	0·1μF 250V	C3	0·05μF 250V
C2	8μF 450V		

Semiconductors:

Tr1	2N2926	Tr4	OC81
Tr2	2N2926	Tr5	2N2926
Tr3	OC81	D1, D2	BY100

Miscellaneous:

Geiger tube type CV2247 (G5H)†; Loudspeaker 30 Ω to 80 Ω type; Transformer type MT98, primary 0-250V, secondary 9-0-9V†; copper laminate printed circuit board etc.

† Available from Henry's Radio Ltd.

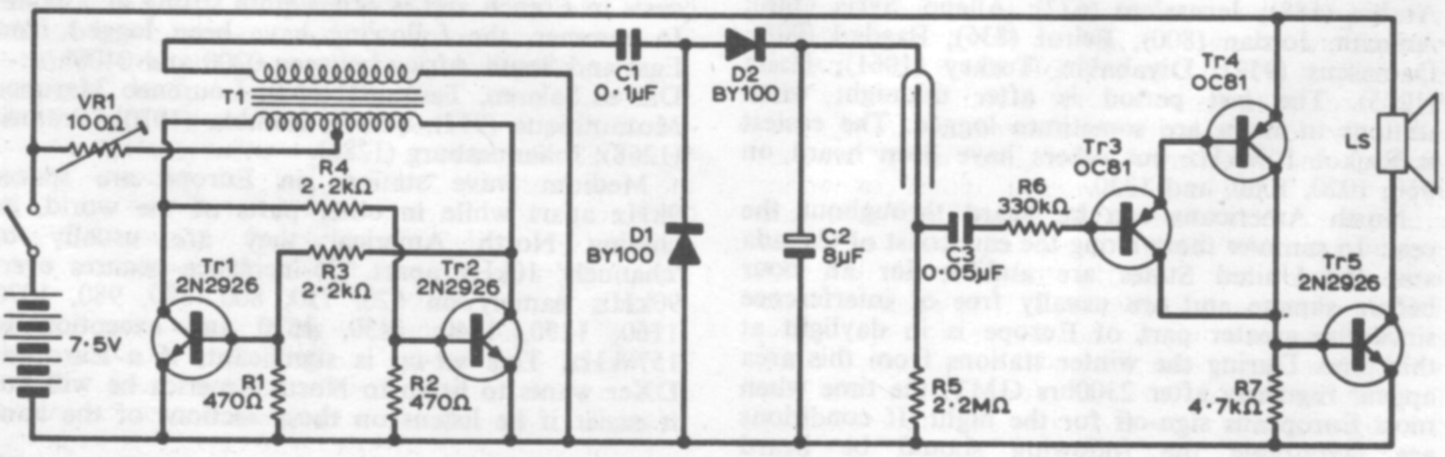

Fig. 1: Circuit of the radioactivity detector.

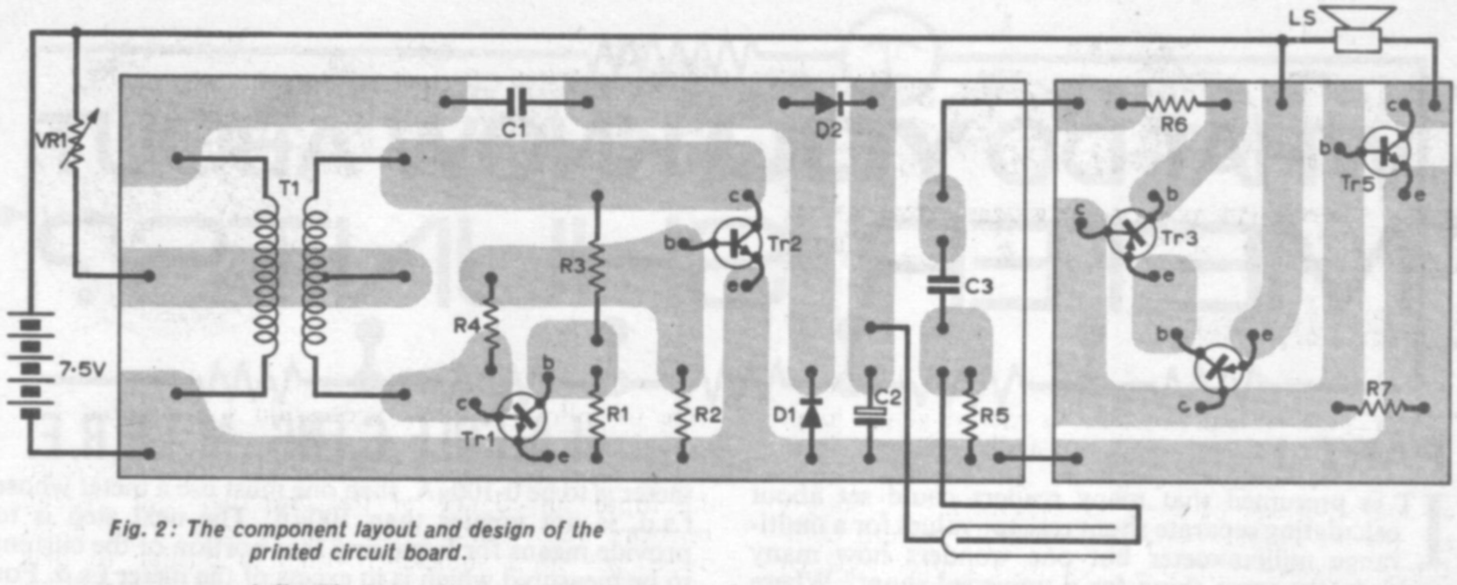

Fig. 2: The component layout and design of the printed circuit board.

unnecessary, especially if they may wish to operate the unit to drive a scaler or an earphone. Consequently the prototype was built on two separate printed circuit boards and Fig. 2 shows the layout pattern which should be painted on a copper laminate board and etched in a solution of ferric chloride.

When the unit is switched on for the first time a meter should be inserted in the battery leads to monitor the current drawn. It should be in the region of 25mA. VR1 can then be adjusted to give the correct operating voltage. The background radiation with the type of tube specified should give a count of approximately 40 per minute but this will vary considerably depending upon the location. ■

MEDIUM WAVE DXING

— *continued from page 963*

where the North American channels are clear of Europeans. For Example, CBA (1070) cannot usually be heard until Paris II signs-off at 2300hrs. On the other hand CJON, St John's Newfoundland on 930kHz can often be heard earlier in the evening since the nearest European frequencies (and QRM) are 926 and 935. Schedules of European stations are important. Many Europeans close down late on Saturday nights but have shorter broadcasting hours on a Sunday. Most, including the BBC, sign-on late on Sunday mornings and many sign-off early on Sunday evenings as well.

DX signals on the medium waves nearly always suffer from slow cyclic fading. The fast fluttery type of fading that can be counted in 'fades per minute' is seldom encountered by the MW DXer. If two stations are heard simultaneously on a channel, it will be found that their relative strengths are changing continually. If the DXer is patient (and lucky) he may hear each station in the clear for a short while during a fade of the other one.

RECEIVERS

It is not necessary to own an expensive communications receiver to DX on the medium waves, especially if a loop is used. Both the R1155 and the PCR receiver are satisfactory. Good sensitivity and selectivity are desirable but freedom from overloading and cross-modulation are of paramount importance and in this respect oldish ex-service equipment excels. The AR88D and the CR100 are popular with MW DXers in this country. The writer uses a CR100 and a BC314, the latter being an l.f. version of the well known BC312. It covers 150kHz to 1500kHz in 4 bands and the i.f. is only 90kHz which gives good selectivity without a crystal filter. The MN26C is similar and more readily available but unfortunately does not have a tuning scale as it was designed for remote control.

Modern communications receivers perform well on the medium waves but beware of double or triple conversion as some are prone to spurios on this band. It is not unknown for modern receivers to have their performance degraded on the MWs, probably to make them suitable for entertainment purposes. If in doubt examine the circuitry and look for damping resistors in the r.f. and mixer stages.

When tuning across the band, switch off the a.g.c. otherwise weak stations close to strong ones may be overlooked. In order to protect the ears use an audio limiter of the type connected between the receiver and headphones.

REFERENCES

There are a number of specialist publications that provide news and information about the MWs. Broadcasting Stations of the World Part 2 published by the US Government Printing Office, Washington D.C. 20402, lists by frequency all broadcasting stations in the range 150kHz to 28MHz except for those in the USA. World Radio and TV Handbook, published annually in Denmark but available in bookshops in the UK, lists MW stations throughout the world as well as containing a mine of information of use to the general DXer. Medium Wave News, the club Magazine of the Medium Wave Circle appears eight times a year and contains recent loggings, station news and information on loops and receivers. Further information can be had from the editor, Ken Brownless, 7 The Avenue, Clifton, York YO3 6AS. For readers in the United States there are the International Radio Club of America, 5421 Clinton Court, Englewood, Colorado 80110 USA and the National Radio Club of America, PO Box 99, Cambridge Mass. 02138 USA. Both clubs specialise in the MWs.

Peak MW DX occurs in years when solar activity is low and since we are currently on a declining part of a sunspot cycle, further outlook is good. Several years of good and improving conditions lie ahead and will no doubt attract many newcomers to the oldest DX band, the medium waves. ■